Transciptome profiling at early infection of Elaeis guineensis by Ganoderma boninense provides novel insights on fungal transition from biotrophic to necrotrophic phase

ABSTRACT

Background: Basal stem rot (BSR) caused by hemibiotroph Ganoderma boninense is a devastating disease resulting in a major loss to the oil palm industry. Since there is no physical symptom in oil palm at the early stage of G. boninense infection, characterisation of molecular defense responses in oil palm during early interaction with the fungus is of the utmost importance. Oil palm (Elaeis guineensis) seedlings were artificially infected with G. boninense inoculums and root samples were obtained following a time-course of 0, 3, 7, and 11 days-post-inoculation (d.p.i) for RNA sequencing (RNA-seq) and identification of differentially expressed genes (DEGs). Results: The host counter-attack was evidenced based on fungal hyphae and Ganoderma DNA observed at 3 d.p.i which became significantly reduced at 7 and 11 d.p.i. DEGs revealed upregulation of multifaceted defense related genes such as PR-protein (EgPR-1), protease inhibitor (EgBGIA), PRR protein (EgLYK3) chitinase (EgCht) and expansin (EgEXPB18) at 3 d.p.i and 7 d.p.i which dropped at 11 d.p.i. Later stage involved highly expressed transcription factors EgERF113 and EgMYC2 as potential regulators of necrotrophic defense at 11 d.p.i. The reactive oxygen species (ROS) elicitor: peroxidase (EgPER) and NADPH oxidase (EgRBOH) were upregulated and maintained throughout the treatment period. Growth and nutrient distribution were probably compromised through suppression of auxin signalling and iron uptake genes. Conclusions: Based on the analysis of oil palm gene expression, it was deduced that the biotrophic phase of Ganoderma had possibly occurred at the early phase (3 until 7 d.p.i) before being challenged by the fungus via switching its lifestyle into the necrotrophic phase at later stage (11 d.p.i) and finally succumbed the host. Together, the findings suggest the dynamic defense process in oil palm and potential candidates that can serve as phase-specific biomarkers at the early stages of oil palm-G. boninense interaction.

Keyword: Early defense; Elaeis guineensis; Ganoderma boninense; Necrotrophic; Pathogenesis-related protein; Transcription factor